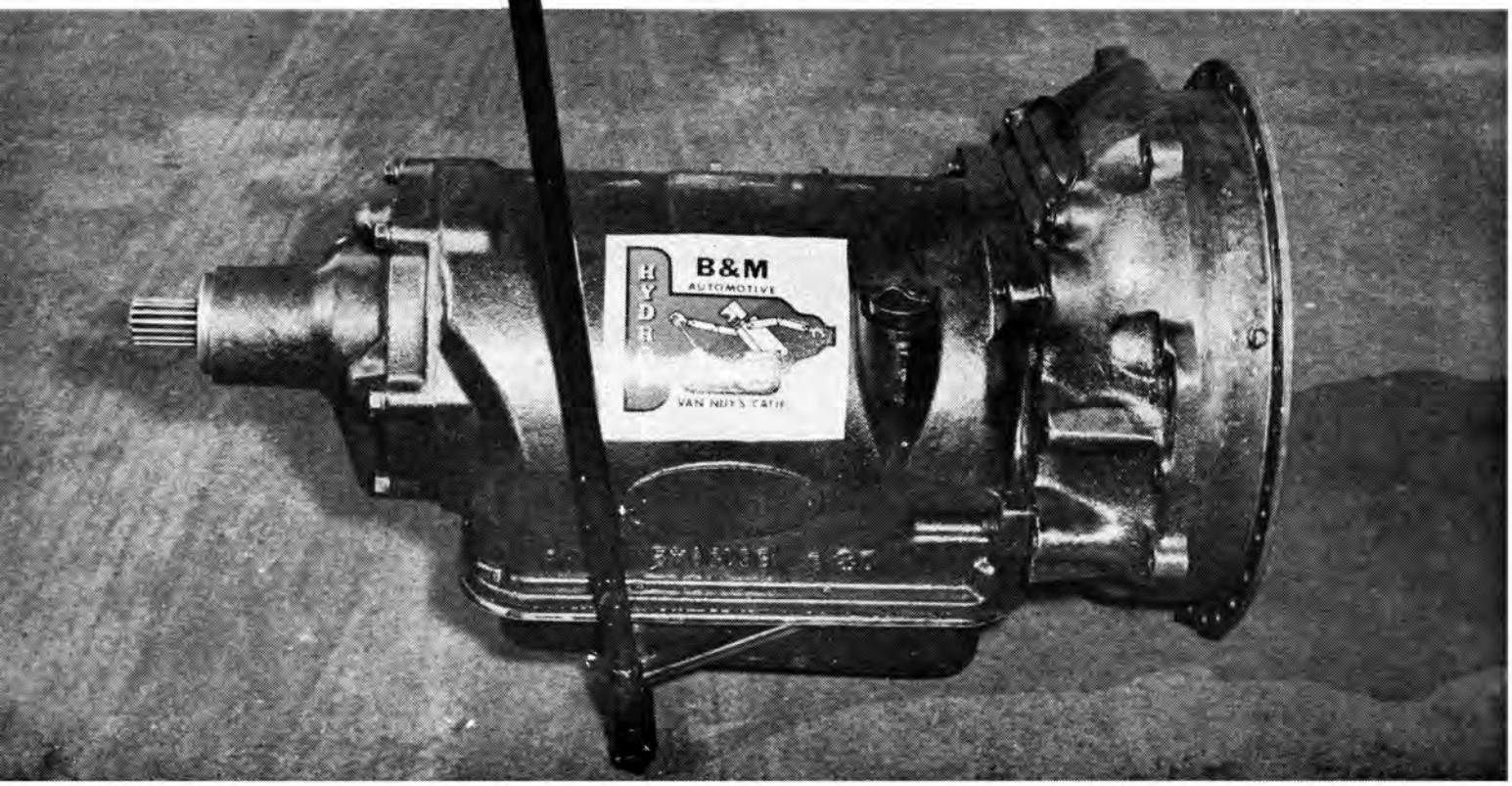
STICK-SHIFT HYDRO'S

Modified and strengthened automatic transmissions —ideal for drags, suitable for street

Text and photos by DON FRANCISCO

Bob Spar, left, and Mort Schuman started B&M Automotive. They and Bob's brother Don worked out the Hydro-Stick.



General Motors' Hydra-matic transmission will become of age in 1960; it will be twenty-one years old. During its lifetime this self-shifter and others that came after it have obsoleted manually shifted gear transmissions for passenger cars and Hydra-matics have replaced stick-shift boxes in other types of vehicles ranging from light trucks to military tanks. The automatic shifting of Hydra-matics has made life easier for all classes of drivers and their smooth, oil-damped method of transmitting torque has increased the life of engines and drivelines in the vehicles in which they have been used. Now, and this is the most important of all to hot rodders, it is possible for Hydra-matics to obsolete stickshift synchromesh transmissions for drag racing cars.

Inherent advantages a Hydra-matic possesses for drag racing are many. One of the most important is that it doesn't require a clutch. Crankshaft torque is transmitted to the transmission by a hydraulic coupling that uses oil instead of actual mechanical contact to transmit the torque gradually and smoothly rather than abruptly in an all-or-nothing manner. This gets the torque to the rear wheels much less violently and allows the tires on the wheels to remain in contact with the strip and start moving the car rather than being spun with a sudden application of force that causes them to lose traction.

Eliminating the clutch automatically does away with the high pressure that is exerted on the flywheel end of the engine's crankshaft when a clutch that has high spring pressure is released. Pressure exerted by the driver on the clutch release pedal forces the clutch assembly and the flywheel toward the engine. This forces the crankshaft against its thrust bearing in the cylinder block because no other provision is made to resist the thrust of the flywheel.

The fact that drag racing engines often blow when gear changes are made in synchromesh transmissions at high crankshaft speeds has caused some hot rodders to theorize that clutch thrust on the crankshaft is the cause of such blowups. The theory is that pressure from the clutch pedal moves the crankshaft forward enough to throw the connecting rods slightly out of alignment with the pistons, making it easy for the already overstressed parts to fail. With a Hydra-matic, the crankshaft is free to rotate freely in any position it seeks in its bearings. There isn't anything to exert a force to move it endwise in the block.

Hydra-matics have four almost evenly spaced gear ratios in comparison to the three ratios in most stick-shift synchromesh transmissions. This is a definite advantage for drag racing because rpm drops between the ratios are smaller. This makes it possible to keep engine speed closer to the desired range from one end of a strip to the other. With a stick-shift box four speeds could be a detriment rather than an asset because of the extra shift that would have to be made. With a transmission that shifts automatically, an extra shift doesn't present any problem.

When speaking of Hydra-matic transmissions it is natural to say that they "shift gears," as one would when describing gear changes in a conventional gear transmission. This isn't an accurate description of what goes on in a Hydra-matic because its gears don't move. A better description would be that the transmission "changes ratios." However, to simplify matters, normal terms relating to gear shifting will be used in this article when reference is made to ratio changes in a Hydra-matic.

Efficiency and weight are often used as arguments against the desirability of a Hydra-matic for competition. There is little to support these arguments. As far as efficiency is concerned, actual racing experience with Hydra-matics installed in place of stick-shift boxes nearly always shows lower e.t.'s and faster speeds with the Hydra-matics. If the power required to drive a Hydra-matic were much more than that for a stick-shift box, it would be reflected by higher e.t.'s and lower speeds. The hydraulic coupling used to drive a Hydra-matic becomes an almost solid driving member at high crankshaft speeds. At most, slippage between its driving and driven members would be only 2 percent.

A Hydra-matic is heavy; no one can deny that. But when compared with a Cad-LaSalle stick-shift box, complete with its bell housing, clutch assembly, flywheel, and scattershield, a Hydra-matic, complete with its bell housing, flywheel, hydraulic coupling, and torus cover, is only 30 pounds heavier. Thirty pounds is thirty pounds in a drag car but it is nothing when balanced against the Hydra-matic's operational advantages.

With all their inherent advantages for competition cars it would seem that more Hydra-matics would be seen at drag races and other competition events. The reasons more of them are not seen are simple: In their stock form they aren't capable of controlling and transmitting the torque developed by a competition engine, and they lack certain refinements that can make their operation more flexible. Many companies that specialize in automatic transmission repair work have been working for years to perfect satisfactory conversion methods that would make Hydra-matics suitable for drag racing and other competition. At least one of these companies, which is B & M Automotive in Van Nuys, California, has the job under complete control. A Hydra-matic converted by B & M is a *complete* transmission.

B & M Automotive became a reality several years ago when two men named Bob Spar and Mort Schuman formed a partnership. Management of the company changed in April, 1959, when Mort sold his share of the partnership to Bob's brother, Don.

Despite all their combined experience with Hydra-matics, it took the fellows at B & M two years just to whip the structural and shifting problems that came to light when a Hydra-matic was installed on a hot engine. This left one more thing to do: find a practical method of making the transmission stay in low gear until the driver wanted it to shift. The fellows found the answer to this problem in November, 1958. Now, there isn't anything a B & M Hydra-matic doesn't do that anyone would want. Because the converted transmissions are so improved, the fellows thought they should be given a new name. As they combine the better qualities of both Hydra-matic and stick-shift boxes, it was decided to call them "Hydro-Stick" transmissions.

Control over all four of a Hydro-Stick's gear ratios is as positive as it is with a synchromesh transmission, with the exception that upshifts and downshifts during normal driving are automatic, just as they are in a stock box. In other words, the transmission will stay in any gear selected by the shift lever when the car is accelerating or traveling at a steady rate of speed. It will stay in the selected gear regardless of how tight the engine is turned or how fast the car goes—it will not shift to a higher gear automatically. When the car decelerates to the normal shift point for its next lower gear the transmission will downshift automatically to that gear. This continues until the transmission drops into low gear, just as a stock trans would. When the car is accelerated again, upshifts are made normally until the gear determined by the position of the shift lever is reached.

Shifts made on acceleration either automatically or under control of the shift lever can be made with the throttle wide-open. There isn't any need to lift the throttle to complete the

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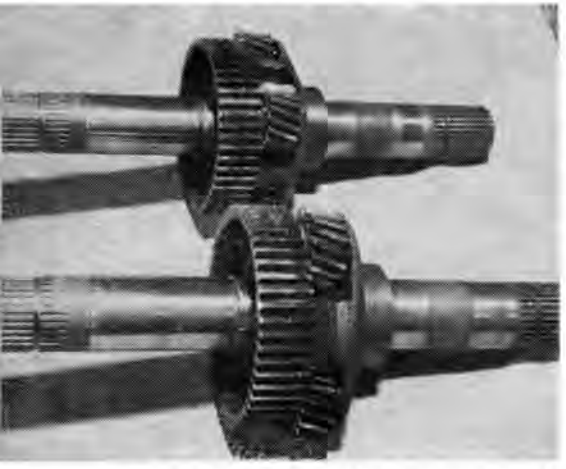
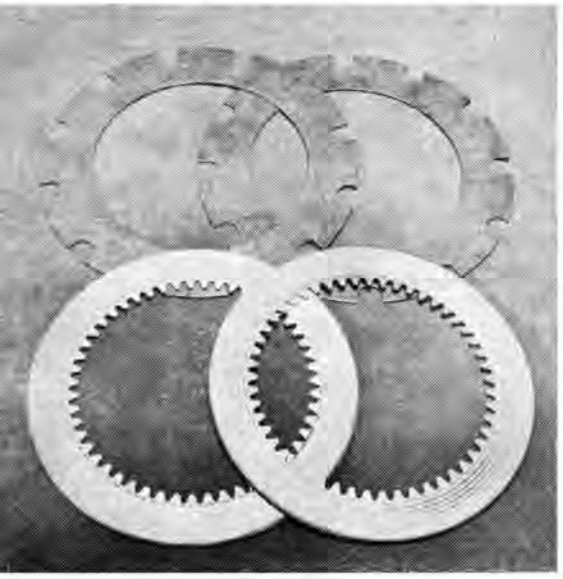
LEFT—Complete box, ready for draggin'. The tall shift lever crosses over under bottom pan to operate linkage on other side.

Hydro-Stick transmission in the Pitman and Edwards hot drag car. Lever assembly under trans is a part of the shift control.



One type of front planet gear assembly used in Hydra-matics has three gears, other has four; both used in Hydro-Stick.



Types of driving and driven clutch plates used in Hydro-Stick box. Material on faced plates differs from standard plates.

STICK-SHIFT HYDROS continued

shift, as there is with some types of reworked Hydra-matics. These shifts are positive but they are not grabby or rough. They have a good, solid feel. Shifts made under part-throttle feel the same as shifts made by a stock box that is in perfect condition and properly adjusted. There's nothing about them to take the joy out of driving. Downshifts for passing can be made by pressing the throttle to the floor, as with a stock trans.

The positive manner in which it shifts makes it possible for a Hydro-Stick to have a much longer service life than a stock Hydra-matic. It might seem strange that a transmission that shifts in a positive manner will last longer than one that gives a hardly perceptible shift but the reason is that the clutches and bands that do the shifting in a Hydra-matic must slip during the shifts if the shifts are to be so mild that they can hardly be felt. Slippage in any mechanical device that depends on friction for its operation causes rapid wear of the device's friction members and creates excessive heat. Eliminating this slippage minimizes wear in a Hydro-Stick. There are Hydro-Stick boxes with as much as 80,000 miles of normal and hard driving to their credit still performing as well as when they were first installed.

A good example of a Hydro-Stick equipped drag racing car is the Pitman-Edwards B-gas coupe. This car is a '40 Willys that has a 4-71 GMC blown 305-cubic inch Olds engine. Before the Hydro-Stick was installed, the car had a LaSalle transmission. Its best e.t. was 12.35 seconds and its top speed was 118 mph. With the same engine and no other modifications other than the installation of the Hydro-Stick, the car's e.t. dropped to 11.52 seconds and its speed went up to 121.29 mph. With the LaSalle box it was squirrely getting out of the chute but with the Hydro-Stick it comes out straight and true. The same locked rear end that was used with the LaSalle box is used with the Hydro-Stick. At this time the Hydro-Stick has been in the car seven months, during which time the car has made over 200 runs. The transmission has not been apart since it was installed. In fact, Pitman and Edwards won't let the B & M boys touch it even for a routine inspection.

Another highly satisfied Hydro-Stick user is Tim Woods, a Los Angeles contractor. When Tim first started using a Hydro-Stick his car was a stock-bodied Olds sedan that he had to load to 4460 pounds for the class in which he ran it. Its stock displacement, 394-cubic inch '59 Olds engine was fitted with a 4-71 GMC blower and a Hilborn fuel injector. The engine had delivered over 600 horsepower on an engine dynamometer. The car's best speed was a fantastic 115.45 mph and its best e.t. was 11.83 seconds, on the San Fernando, Calif., drag strip. It clocked these speeds and e.t.'s consistently.

The Hydro-Stick in Tim's Olds, which belonged to B & M, had a record of over 60 runs and was still operating flawlessly when Tim decided to change to a Studebaker chassis. After cutting the engine's displacement to 340 inches by sleeving its cylinders, he dropped it into the Studebaker with a stick-shift transmission. The car began its career by having trouble getting off the line and turning high e.t.'s and low speeds. Tim couldn't see any future in this so he replaced the stick-shift box with another Hydro-Stick, which he bought. Now the car is turning e.t.'s in the 11-second bracket and its best speed to date is 119.94 mph, on the Bakersfield, Calif., strip. As far as Tim is concerned, the Hydro-Stick is the only transmission for competition.

B & M can't make a Hydro-Stick out of just any Hydra-matic. The models they prefer are '53 through '56 Olds, '55 and '56 Pontiacs, '53 through '55 Cadillacs, and '53 through '55 Lincolns. All these are dual-range transmissions. Certain earlier models can be used but so much extra work must be done to them to bring them up to the capabilities of later boxes that they aren't practical.

Exceptions one might find in the transmissions listed are the dual coupling units that were used in some late '56 Oldsmobiles, Cadillacs, and Pontiacs. These were called "Jetaway" by Olds and Cadillac and "Strato-Flyte" by Pontiac. A hydraulic coupling used in place of the front clutch unit in these and all later Hydra-matics ruins the transmissions as far as converting them to Hydro-Stick boxes is concerned. However, a Hydro-Stick can be installed in a car that was originally equipped with a dual coupling transmission, or with any other Hydra-matic, for that matter, without any trouble. It is also easy to install one of them in a Chevy V8, and the fellows at B & M are now working on the adapter parts necessary for Buick V8's and Ford product engines.

Converting a stock Hydra-matic to a Hydro-Stick requires modifications to many of the transmission's parts, and all its parts are rebuilt or replaced to make them serviceable. The modifications can be divided into two general classifications: those that improve the transmission's ratio changing ability, and those that give its parts greater strength.

The force in a Hydra-matic that does the actual work of changing its output ratios is oil pressure. In standard transmissions this pressure reaches maximum values of 75 to 90 psi, depending on the engine with which the transmission will be used. One exception to this is the unit built for Cadillac ElDorado engines which has a maximum pressure of 112 psi.

Most Hydro-Stick boxes are set up to operate on a pressure of 185 psi. The actual pressure requirement for a given car is determined by the car's weight and the power of its engine. Instructions provided with each Hydro-Stick describe methods for adjusting the transmission's relief valve to raise or lower the pressure until the transmission shifts to suit the car's driver.

At B & M the terms "soft" and "bogging" are used to describe shifts in their Hydro-Stick boxes. A soft shift is one that is hardly noticeable. This is nice for the driver and passengers but indicates slippage in the shifting units. More oil pressure is required. A bogging shift is one during which the transmission tries to engage two ratios at once during the shift from second to third ratio. It is caused by too much pressure.

Two pumps supply the oil pressure in a Hydra-matic. One of these, which is the front pump, is driven by the transmission's input shaft and the other, which is the rear pump, is driven by the output shaft. Duties of the rear pump are to create pressure when the car's driveshaft is rotated by pushing the car, such as when a car is being pushed to start its engine, and to assist the front pump in maintaining the required pressure and volume. Rear pumps were discontinued in transmissions built for 1959 automobiles; in Hydro-Stick transmissions they are used in their stock form.

Early in their Hydra-matic conversion program the fellows at B & M found that standard front pumps in the transmissions they recommend for reworking become inoperative at high discharge pressures. This characteristic is due to the design of the pumps. Although a pump's rotor can be rotating at high speed, the pump will not deliver any pressure or volume. This causes the transmission to quit working. These pumps have a relief valve which, under normal conditions, controls their pressure output.

Originally, the standard pumps were reworked to allow them to deliver pressure at high speeds. Now, a different pump is used. This pump does not have a relief valve. Also, its rotor is made of material so much better than that in standard rotors that it will not break regardless of the speed it is rotated or the pressure the pump delivers. This pump is interchangeable with the standard pumps in transmissions used for Hydro-Stick conversions and it can also be installed in earlier transmissions by making minor modifications to a few related parts.

Oil flow in a Hydra-matic's control system is directed by a valve body which, in turn, is controlled by the driver by means of the lever mounted on the car's steering column. The valve body for a Hydro-Stick is reworked to permit complete four-gear control, as described previously, without destroying the transmission's automatic features. Included in this reworking is the installation of a first-gear control on which a patent is now pending. This control is a feature used exclusively in B & M conversions.

Both clutch assemblies are modified to enable them to accommodate more driven and driving plates. Eighteen plates are used in the rear clutch in place of the standard sixteen, and ten are used in the front in place of the standard eight. All lined plates are replaced with plates that have better friction qualities than standard plates. These plates enable a Hydro-Stick to shift gently under light throttle conditions and in a harder, more positive manner under full-throttle.

Modifications are also made to the front clutch to make it release quickly to match the fast application of the rear clutch made possible by the high oil pressure in the control system. It is necessary for the front clutch to release as quickly as the rear clutch engages if the transmission is to shift smoothly from second to third.

Raising the oil pressure in the control system aggravated normal oil leakage problems. The principal point of leakage from a standard Hydra-matic is usually considered to be its front seal. This seal is supported by the front pump housing and its sealing member contacts a lip on the rear of the torus cover. However, at B & M it was determined that this seal leaks only when it is old, worn, and hard. Leakage attributed to it usually can be traced to the joint between the front pump housing and its recess in the front flange of the transmission case. An O-ring around the pump is supposed to seal this joint but under conditions of high pressure, high rotational speeds, and high torque the transmission housing can distort enough to allow oil to leak past the ring. The oil then passes through the joint between the transmission case and the flywheel housing and is lost. Another point where a Hydra-matic

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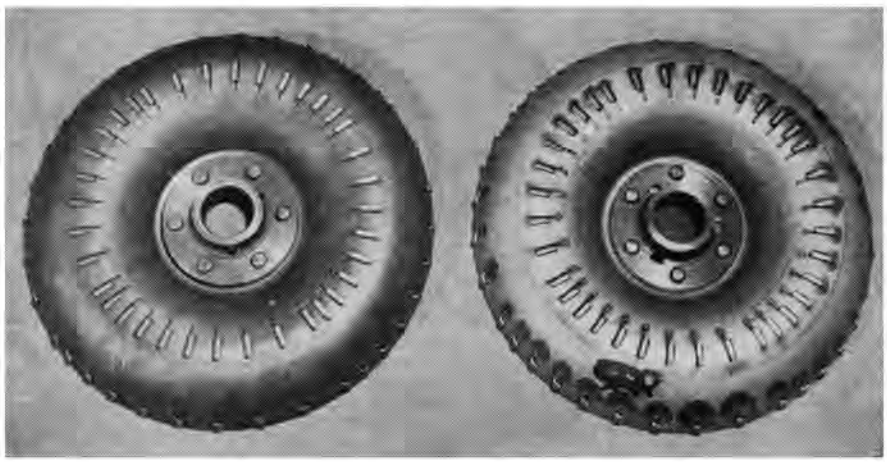
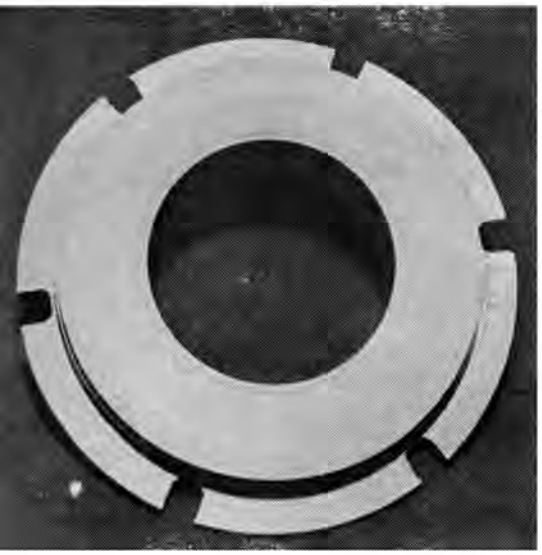
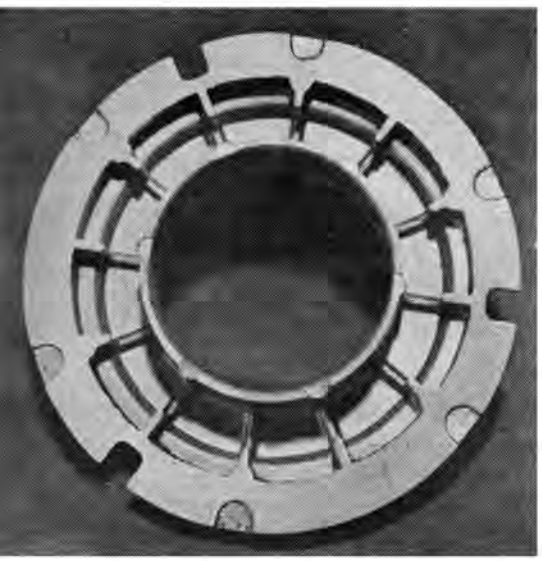
TOP—Vanes in torus member of hydraulic coupling, standard equipment with 1950-53 Olds Hydra-matic, are partially cut away.

ABOVE—Vanes in torus members of 1949, '54 and later Olds Hydra-matics have full area for transmitting torque to the trans.



Two types of torus members used with Chevy Hydra-matics. Vanes in the one on the left are merely crimped to hold them in place; in right one they are furnace brazed.





TOP—Annular pistons accuating clutches in a Hydro-Stick are reworked in lathe to make room for the plates that are added to give the clutches greater holding capacity.

ABOVE—Outer side of reworked piston. Duty of the pistons is to transmit hydraulic pressure to plates in the clutches that help the transmission change output ratios.

is apt to leak is through the joint between the flywheel and the crankshaft flange. This joint is exposed to pressure created inside the torus cover by torus members.

All the available means and methods of stopping oil leakage were tried by the fellows at B & M. Nothing worked. They finally eased their problem onto a local chemical company. This company developed a sealant that can be applied in paste form and that hardens to a tenacious, rubbery solid that is not affected by oil, water, or gasoline. The sealant is applied to the surface of the flywheel housing to which the transmission case is bolted and to the crankshaft flange in the flywheel. After the parts are bolted together, it hardens and forms a positive seal. No matter how much the parts distort, the sealant adheres to them and prevents the passage of oil between them. Oil leaks have become a thing of the past since B & M started using this special sealant.

Modifications made to increase the strength of a Hydro-Stick's parts that transmit torque depend on whether the engine is to be used on a blown or naturally aspirated engine. A few more modifications are made in a transmission for a blown engine to enable it to hold the terrific torque output such engines can create and to move the heavy weight of the stock-bodied cars in which blown engines are often used.

Nothing is done to the torus members of the hydraulic coupling that drives the transmission. However, there are three basic types of couplings that B & M uses. Two of these can be used on all transmissions except those to be installed on Chevy engines and the other is for Chevys only. Chevy couplings differ from the others by having a smaller outside diameter.

One of the larger couplings was standard equipment in '49 Oldsmobiles and the other was used in '50 through '53 Oldsmobiles. The difference between them is in the vanes in their torus members. Vanes in a '49 member are so-shaped that their edge that is at the open side of the member is flat and unbroken throughout its length. Vanes in '50 through '53 members are similar to those in '49 members with the exception that material has been removed from their side nearest the open side of the member to match the contour of a ring that is concentric with the member's housing and supported by the vanes. The ring's convex shape becomes one-half of a tubular ring formed when the two members of a coupling are in their correct positions in relation to each other. The effect of this ring is to reduce the amount of torque transmitted from the driving member to the driven member at low crankshaft speeds.

At B & M, '49 couplings are used with Hydro-Stick transmissions to be installed on engines that are carbureted and otherwise set up for street driving. Engines of this type have a good torque output at low crankshaft speeds, making it practical to deliver torque to the transmission and rear wheels at comparatively low crank speeds. If an engine has multiple carburetors, a fuel injector, or one or the other of these setups and a blower, and is modified in other ways for serious competition, its torque output at low crank speeds will be comparatively low. Such engines benefit from a '50 through '53 coupling that slips a little more at low speeds. This slippage lets an engine reach a higher crank speed before the coupling starts to deliver an appreciable amount of torque to the transmission and the rear wheels.

Actually, the difference in the torque delivery characteristics of the two types of couplings isn't great but it is enough to be noticeable. A car with a stock or a semi-stock engine will get out of the chute on a drag strip with minimum wheelspin when fitted with a '49 coupling but may have too much wheelspin when fitted with a '50-'53 coupling that allows crank speed and torque to come up a little higher to get the car off the line. On the other hand, a highly modified engine with a '49 coupling may lug off the line with too low a crank speed but come out charging with a '50-'53 coupling.

Torus members in couplings for '54 and later transmissions have vanes similar to those in the '49 type but their mounting bore diameters are different. Couplings of the '50-'53 type are not available for these transmissions. Chevy couplings are similar to '54 through '56 Olds couplings except for their smaller diameter. However, there are two types of these couplings. In one the vanes are merely crimped to hold them in place, and in the other the vanes are furnace brazed as well as crimped. Couplings with brazed vanes must be used with a Hydro-Stick because vanes that aren't brazed work in their slots in the torus shell and crack the shell when the coupling is rotated at high speeds.

It is common practice with Hydra-

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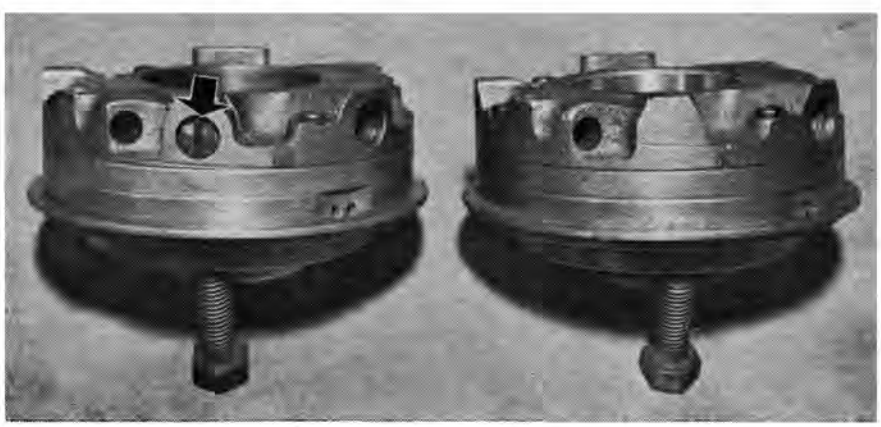
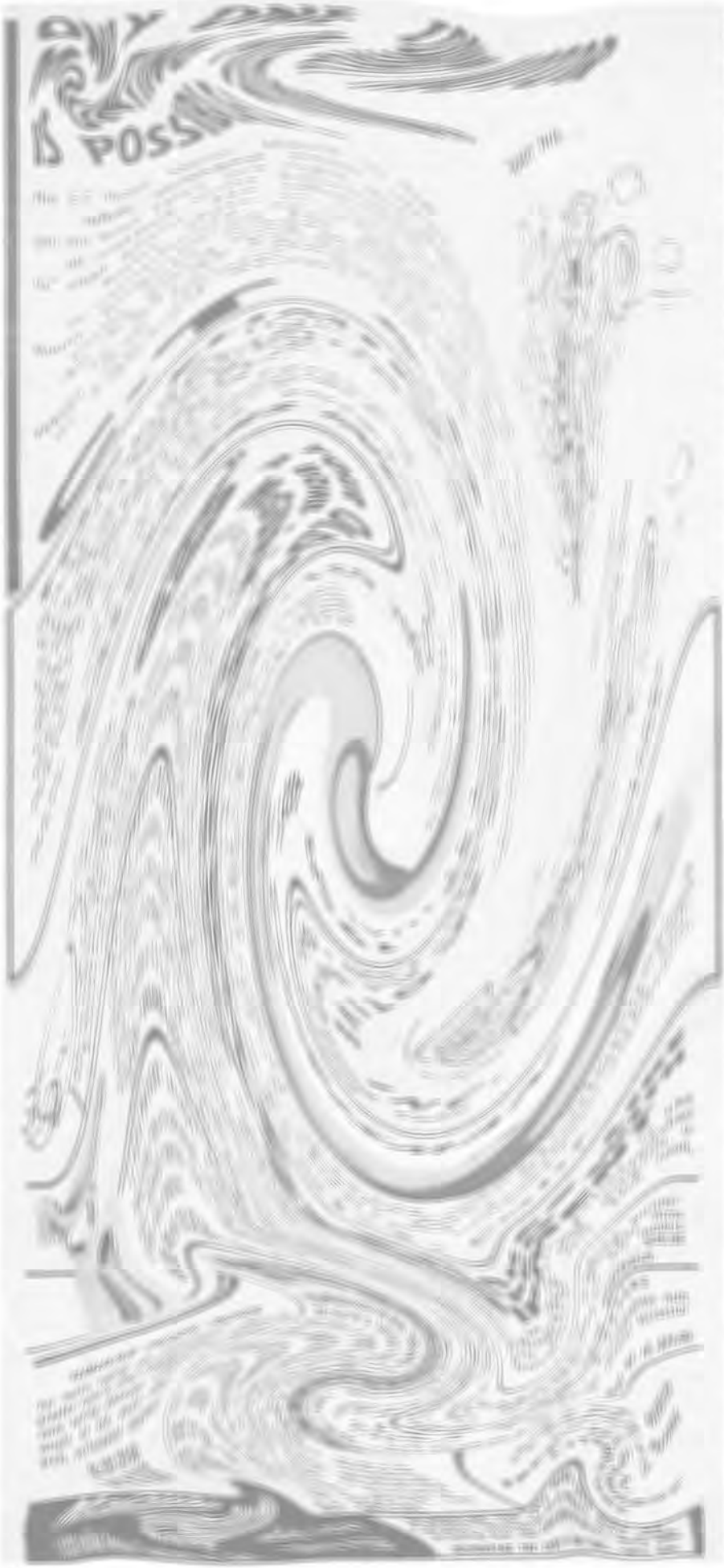


Standard front pump at left with special pump used in Hydro-Stick conversion. Arrow indicates relief valve in standard pump; special pump does not have a relief valve.



STICK-SHIFT HYDROS

continued from page 46

matics in drag racing cars to lock the transmission's throttle-operated pressure control lever in its full-forward, maximum pressure position so that the oil pressure in the transmission's shifting system will be at a maximum at all times. This is all right for full-throttle shifts but it makes part-throttle shifts and downshifts very severe. Downshifts can become so severe that parts in the transmission break.

If the lever is to be locked in its full-forward position, B & M recommends that it be done with a flexible control cable of the locking type. This will make it possible to move the lever and lock it in the forward position for a drag race and then move it to its full-back, minimum pressure position for downshifting and the return trip to the starting line. When moving the lever, only a little force is required on the cable. Too much force can spring or bend the shaft on which the lever is mounted.

A better method than controlling the lever with a manual control is to use correctly adjusted linkage between the lever and the carburetor that will move the lever to its full-forward position in the standard manner when the throttle is in its full-open position. For drag racing, such linkage should be adjusted so that it holds the lever in a position approximately half way between its full-forward and full-back positions when the throttle is in idle position. Advancing the lever in this manner in relation to the throttle guarantees that the pressure in the transmission will be high enough to eliminate slippage in the shifting units and to provide positive shifts while getting out of the chute. However, the pressure will not be so high that the transmission won't shift smoothly at part throttle and downshift gently. For street driving, the linkage should be adjusted in the normal manner. This is so that the transmission lever is in its full-back posi-

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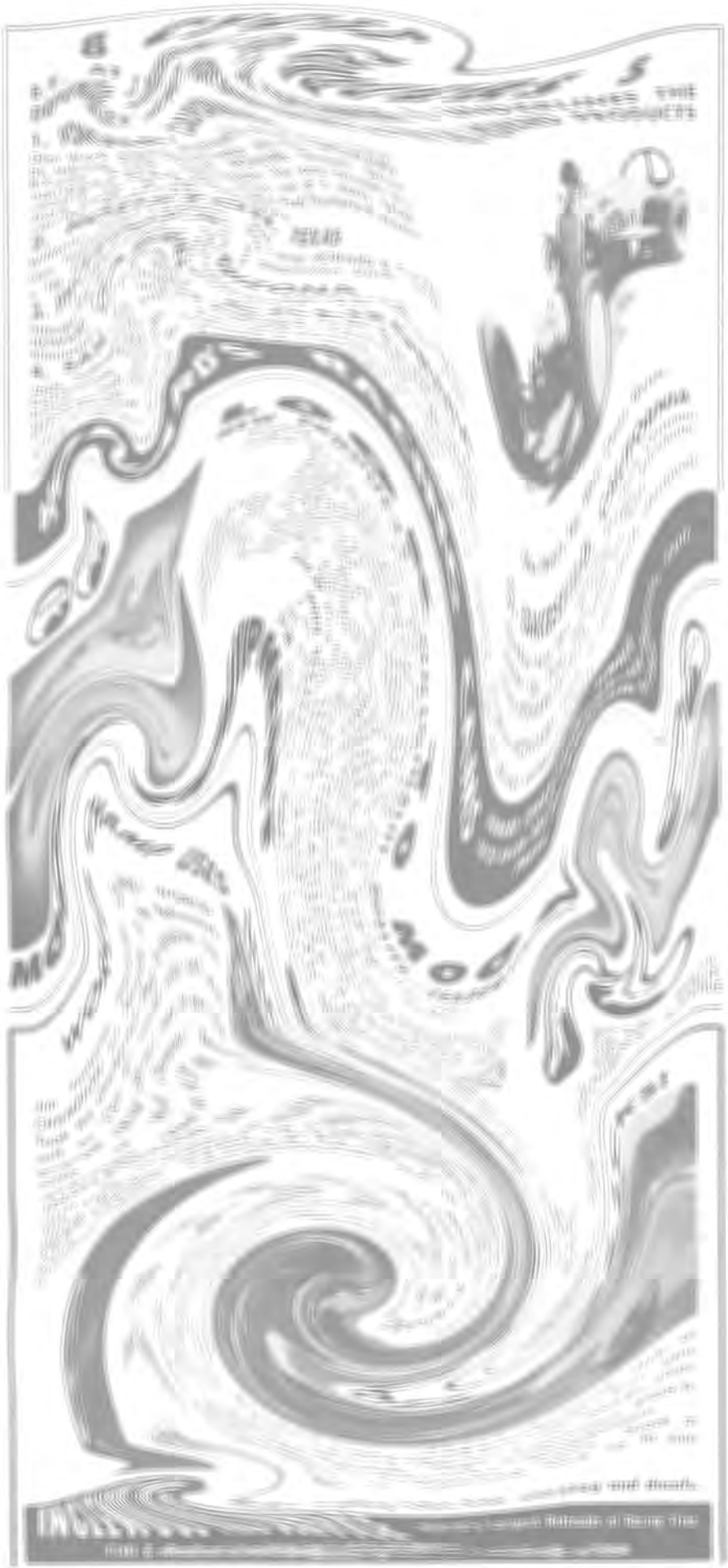
"Who's been fooling around with my pipes?"



tion when the throttle is closed and full-forward at or a little before full throttle position is reached. A certain amount of experimentation is usually required to obtain the exact adjustment to suit the car and driver in each case.

There's only one thing about a B & M Hydro-Stick that the average hot rodder won't like, and that's its price. For a complete job on your transmission the charge is $195.00 for units to be used with normally aspirated engines and $235.00 for units to be used with blown engines. Added to these prices are applicable taxes and shipping charges. For the fellow who doesn't have a transmission or has one that isn't the correct type for rebuilding, B & M will supply the basic transmission, complete to the flywheel, for an additional $65.00 to $95.00, depending on the year and model of transmission desired. All Hydro-Stick units are guaranteed for 4,000 miles or 90 days.

Available separately is the front oil pump that has the more durable rotor described previously. The price is $32.00, exchange. The special sealant is available for $5.95, postage paid.

The only way to describe a Hydro-Stick conversion is to say "This is it." It is the answer to transmission and clutch problems for both competition and street machines. It has all of a standard Hydra-matic's automatic features plus the ability to be controlled manually when it is necessary to run an engine at high crankshaft speeds to get the last ounce of pressure it can deliver. Add to these things the lighter shock loads a Hydra-matic transmits to a car's driveline components, compared to those the components receive from a conventional transmission and clutch combination, and the longer driveline life and better car handling that result, and you've got quite a package.

All this, combined with a transmission life expectancy reported much greater than that provided by a stock Hydra-matic, can mean only one thing: This is it!

"I'll have it fixed in a jiffy—it's just a stuck valve!"